ABSTRACT OF THE DISCLOSURE

A time-of-flight mass analyzer having improved mass resolution without mandating a corresponding increase in instrument size is disclosed. The analyzer includes an ionizer that generates the ions that are to be analyzed. These ions are introduced to an ion flight path, at least a portion of which is aligned with a linear axis. The portion of the ion path that is aligned with the linear axis includes a region having a substantially static electric field with non-linear equipotential field lines that circumvent the linear axis. Ions either enter the substantially static electric field with a velocity component that is directed along the linear axis or have such a velocity component imparted to them once they have been trapped in the substantially static electric field. As a result of the combined effects of the linear velocity component and the non-linear field, the ions make multiple circumnavigating trips about the linear axis as they concurrently travel in the direction of the linear axis. Consequently, the ions travel along a significantly longer flight path when compared to a flight path in which the ions solely travel linearly along the axis. In one embodiment, the concurrent motions of the ions in the direction of the linear axis and along the equipotential field lines about the linear axis define a substantially helical ion trajectory. This provides a larger distance along which ions having close, but different, *m/z* may be separated in time thereby providing an instrument having higher resolution.